ADVANCING GLACIER POSES A POTENTIAL FLOODING THREAT TO YAKUTAT, ALASKA

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Background

The Hubbard Glacier, located 30 miles north of Yakutat, Alaska, is the largest tidewater glacier in North America and has been slowly advancing towards the Gulf of Alaska the past century. During the summer of 2002, the Hubbard Glacier created a glacial ice and moraine dam across the entrance to Russell Fiord. This halted tidal influences into the fiord and resulted in the creation of Russell Lake. Runoff from 695 square miles of glaciated uplands filled the 39 mile long, 70 square mile lake at a rate of one half foot per day during July 2002. By mid-August, heavy rains pushed this rate to almost 3 feet per day with the lake level climbing to 61 feet above sea level before the glacial dam failed the morning of the 14th. This released an incredible torrent of water, ice and debris into a 300 foot wide by 600 foot long channel connecting Russell Lake to the sea. By the afternoon of the 15th, the lake level had fallen to sea level with tidal influences returning.

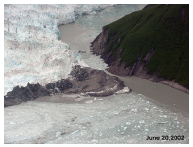
Heavy rains dropped nearly 6 inches of rain on Yakutat August 11-12, 2002, with much higher amounts over the basin feeding Russell Lake. This may have tipped the balance in favor of the dam's erosion, though other factors such as possible slow down of the glacier' movement or reduced growth of the moraine may also have played a role.

Hubbard Glacier most previously blocked the entrance to Russell Fiord in May 1986. After that closure, freshwater flowing into the fjord raised the level of the lake 84 feet before the ice dam failed about 5 months later in October 1986. Since 1986, Hubbard Glacier has continued to advance into Disenchantment Bay and Russell Fjord at an average rate of about 105 feet per year, but large tidal currents have kept a channel open between the glacier and the hills to the south. The rate of advance across the narrow channel connecting Russell Fjord to the sea has averaged only about 20 feet per year. (USGS News Release June 18, 2002)

Right: Map of the Yakutat area showing Hubbard Glacier, Russell Fiord, and the Gulf of Alaska.

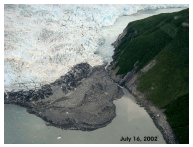
The Big Event

JUNE 14, 2002: The advancing Hubbard Glacier and terminal moraine begin to constrict tidal flow into Russell Fiord.



JUNE 20, 2002: The gap between Russell Fiord and the sea continues to narrow. Ice buildup is further impeding the exchange of water, and the lake level is beginning to rise.

JULY 3, 2002: Tidal inflow has ceased into Russel Fiord. The lake level is rising approximately 6 inches per day.

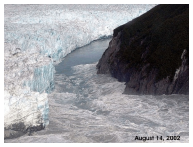


JULY 16, 2002: The moraine continues to rise ahead of Hubbard Glacier. It is estimated to be over 100 feet high.

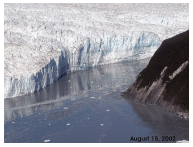
JULY 21, 2002: The moraine has completely closed the gap between Russell Fiord and the sea.

August 10, 2002: The level of Russell Lake continues to rise due to runoff and glacial melt in the basin, even though water begins to flow over the moraine and into the sea.

AUGUST 14, 2002 12PM: Heavy rains raised the water level in Russell Lake to 61 ft above sea level before the moraine failed about 9 hours prior to this photo.



AUGUST 14, 2000 5PM: The torrent of water draining Russell Lake has scoured away the last of the moraine. It is estimated that standing waves were nearly 50 ft high.



AUGUST 15, 2002: A sheer 300 ft high wall of ice lines the passage between Russell Fiord and the sea. Russell Lake completely drained through the narrow channel in 36 hrs.

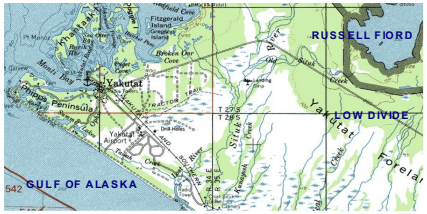
AUGUST 26, 2002: Constant tidal action has widened the opening to Russell Fiord. Silt-covered low lands in the background were under water 2 weeks ago.

Potential Flooding Threat

Future closures of Russell Fiord are considered imminent and will likely result in a larger and more stable dam. This scenario poses significant risks to Yakutat because if the lake level were to exceed approximately 131 feet, water would begin to spill from it's south end into the Situk River and lowlands around the community. This would allow water to inundate national forest and private land, as well as significantly alter a world-class fishery, which would have a major impact on the local economy.

The one-hour peak discharge of 1.9 million cfs reached on August 14, 2002 is the second largest glacial lake outburst world wide in historical times, exceeded only by the 1986 outburst from Russell Lake, which was about 3.7 million cfs. In comparison, the August 14th peak discharge was about 30 times greater than the peak historic flow on the Mississippi River at Baton Rouge, LA. (USGS News Release August 16, 2002)

Above: The rising waters of Russell Lake inundate the surrounding forest.



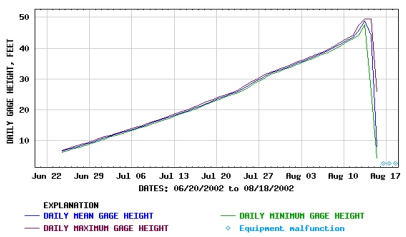
Above: Topographic map showing the low divide between the south end of Russell Fiord and the Situk River Drainage near Yakutat, Alaska.

Actions Being Taken

The National Weather Service along with other Federal, State, Tribal, and local officials are closely following the glaciers activities and have set up a task force to address the issues associated with the potential flooding of the Situk River drainage.

Researchers are re-surveying the divide between Russell Fiord and the Situk River basin using more advanced mapping techniques to determine the likeliest locations for overflow to occur. They are also examining the density and types of vegetation that may contribute to debris dams that could divert water as it flows through the greater Situk River watershed. Hydraulic engineers have been working with the mapping crews to examine the potential routes for water as it flows towards the sea and the impacts this could have on the airport and area roads.

Initial estimates if Russell Lake overflows into the Situk River drainage are that the overflow will begin with a Russell Lake stage of 131 feet above sea level. Within a week, average discharge into the Situk will be approximately 20,000 cfs with discharges above 50,000 cfs possible with heavy rain or snowmelt. Average flows in the Situk River are in the range of 1200 cfs, with recent highs of 3800 cfs in 1999. (Information courtesy of the USGS)

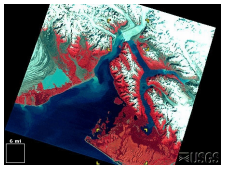


Above: USGS Hydrograph shows a steady rise in the stage of Russell Lake and the rapid fall after the dam failure on August 14, 2002.

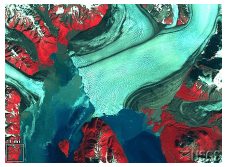
Conclusions

The advancing Hubbard Glacier is expected to create future closures of Russell Fiord and perhaps form a more permanent ice and moraine dam. It is estimated that if the Fiord reaches a level of 131 feet above sea level, water will overflow into the Situk River drainage. The impacts of such an event could be catastrophic to the community of Yakutat. As additional mapping and research of the Situk basin become available, actions will be taken to examine possible mitigation efforts.

The National Weather Service is applying best practices by working closely with other Federal, State, Tribal, and local officials in developing a flood contingency plan for the community of Yakutat.



Above: Landsat image of the Yakutat area showing the Hubbard Glacier, Russel Fiord, and the Gulf of Alaska. (USGS).



Above: Landsat image of the Hubbard Glacier closing the gap between Russell Fiord and the sea (USGS).

This glacial outburst event was more than just a potential hydrologic hazzard, it also created problems for the marine community. An extreme volume of water along with large chunks of ice and debris poured into Yakutat Bay and threatened ship traffic sightseeing near the glacier. This prompted the NWS to issue a special marine warning the morning of August 14th.

Right: A cruise ship races away from Hubbard Glacier as ice and debris draining from Russell Lake are swept into the sea.

Acknowledgements

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